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SUMMARY

In populations of wild house mice extremely high and low aggressive males are abundant, which is the result of diversifying natural selection. The aggressive mice are more successful under stable conditions (like within a family group, called a deme), whereas non-aggressive males function better under changing conditions (i.e. migratory circumstances). These findings implicate that not only aggression, but also the absence of aggression belongs to the functionally significant equipment with which animals interact with the social environment. A second implication is that aggressive and non-aggressive male mice may differ more fundamentally in their general interaction with the environment, regarding their different success under different conditions. Therefore, the following questions are addressed in this thesis: 1) do aggressive and non-aggressive mice respond in alternative ways to various social interactions, 2) do aggressive and non-aggressive male mice differ more generally in behavioural strategy in response to non-social situations and 3) can the supposed difference be interpreted in terms of different, but equivalent coping styles?

An aggressive male mouse, i.e. an individual that responds actively to territorial intrusion, flees or escapes from a physically stronger residential male. In contrast, a non-aggressive male responds not only passively to territorial intrusion, but also when attacked by a resident it shows withdrawal, i.e. it responds with immobility (ch. 2). These socially active and passive strategies extend to non-social situations. Aggressive mice are relatively good active shock avoiders (which reflects an active defence reaction), whereas the immobility of the non-aggressive mice in the shuttle-box interferes with the execution of a conditioned avoidance response (ch. 3). Likewise, in an uncontrollable aversive situation, i.e. exposure to inescapable shocks, aggressive mice adopt an active strategy and consequently maintain their exploratory activity, possibly in an attempt to escape. Non-aggressive males once more assume a passive strategy and show a dramatic cessation of activity (ch. 4). Although a passive behavioural strategy has generally been related to a loss-of-control state, it is argued that the difference in general behavioural strategies between aggressive and non-aggressive mice in fact represent two different, but equivalent coping styles. The coping style of the aggressive males is aimed at the removal of themselves from the source of stress or at removal of the stress source itself (i.e. active manipulation). Non-aggressive mice seem to aim at the reduction of the emotional impact of the stress (i.e. passive confrontation; ch. 9).

The fact, as indicated before, that aggressive mice are more successful under deme (stable) conditions and non-aggressive males under migratory (changing) conditions may imply that the differential behavioural strategies of the aggressive and non-aggressive mice are suited to different environmental circumstances. Indeed, the performance of aggressive males is more efficient in a maze with an invariant configuration, whereas that of non-aggressive mice is better when the configurations are continuously changed (ch. 5).

Aggressive animals seem to readily form routines during repeated execution of a particular behavioural pattern, whereas non-aggressive mice fail to do so. This assumption is confirmed by the results of an experiment in which the animals are forced to take a particular route to the food compartments in a Y-maze. Upon reversal of the accessible arm the aggressive mice have difficulties in shifting their locomotion pattern, whereas the non-aggressive males readily adjust their pattern (ch. 6). Due to the formation of routines the behaviour of the aggressive males becomes relatively independent of external stimuli, whereas that of the non-aggressive mice remains dependent on external stimuli and hence their behaviour is more flexible. Also in social situations aggressive mice readily form routines; their attacking behaviour is fairly routine-like. After repeated experience with male opponents they fail to adjust their behaviour appropriately when their own female is introduced as intruder (ch. 6). The foundation of the difference in flexibility of behaviour between aggressive and non-aggressive mice may be sought in the organization of behaviour. The balance between intrinsic and extrinsic determinants of behaviour may be different in aggressive and non-aggressive mice. Dopaminergic mechanisms in the brain may be of importance in this respect. The amount of apomorphine-induced stereotypies is much greater in the aggressive than in the non-aggressive mice. This indicates that aggressive males have a relatively low dopaminergic activity within the neostriatum and that non-aggressive mice have a relatively high dopaminergic activity (ch. 8). The fundamental character of the difference between aggressive and non-aggressive mice in their organization of behaviour becomes clear when the circadian rhythmicity of activity is studied. As expected, non-aggressive mice have a faster rate of re-entrainment when the light-dark cycle is inversed than aggressive males. Moreover, the intrinsic organization of the endogenous clock (the pacemaker) seems to be stronger in the aggressive than in the non-aggressive mice. Aggressive males show invariable tau-values (period of the endogenous clock) that are close to 24 h, whereas non-aggressive mice show variable tau-values that deviate considerably from 24 h (ch. 7).

The different behavioural profiles are found in mice artificially selected for high and low aggressiveness as well as in animals of an unselected control population. Therefore, genetic differences play a significant role in the differential behavioural profiles of male mice. Aggressive mice generally adopt an active behavioural strategy in order to manipulate a situation. Their routine formation probably contributes to a fast execution of anticipatory responses, which are necessary for an effective manipulation of events. It may be clear that this is only of advantage in predictable (i.e. deme) situations, but is maladaptive upon entry of the unexpected. Non-aggressive mice predominantly adopt a passive strategy; they conform to the situation for which flexible behaviour is indispensible. Under changing conditions (i.e. migratory circumstances) this cautious behaviour, depending strongly on external stimuli, will be of advantage. Thus, both aggressiveness and non-aggressiveness are parts of different and qualitatively equivalent coping styles that are suited to different environmental conditions.